IN THE CLAIMS

This listing of claims replaces all prior versions and listings of claims in the above-referenced application.

1. (Currently Amended) A light emitting diode comprising:

a first semiconductor layer doped with a first dopant, coupled to a first electrode layer;

an active layer overlying said first semiconductor layer, capable of emitting light;

a second semiconductor layer doped with a second dopant, overlying said active layer, said first dopant and said second dopant being of opposite type;

a second electrode layer on said second semiconductor layer; and

a periodically-arranged plurality of holes formed in the second semiconductor layer and extending towards the first semiconductor layer, wherein

the ratio of the period of said periodic arrangement and the wavelength of said emitted light in air is greater than about 0.1 and less than about 5;

a depth of at least one of the plurality of holes is such that a thickness of said second semiconductor layer at a bottom of said at least one of the plurality of the holes is less than about one wavelength of said emitted light in said second semiconductor layer; ~~and~~

a portion of the second electrode layer is disposed in a region of the second semiconductor layer in which a portion of the plurality of holes are formed; and

when forward biased, light is emitted from at least a portion of the active layer disposed beneath a portion of the second electrode.

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2. (Original) The light emitting diode of claim 1, wherein

said first dopant is n-type and said second dopant is p-type.

3. (Original) The light emitting diode of claim 1, wherein

said first semiconductor layer overlies said first electrode layer.

4. (Previously Presented) The light emitting diode of claim 1, wherein said first electrode layer partially overlies said first semiconductor layer; and said first semiconductor layer overlies a substrate with a reflective surface.

5. (Previously Presented) The light emitting diode of claim 1, wherein said first electrode layer partially overlies said first semiconductor layer; said second electrode layer is reflective; and said first semiconductor layer overlies a transparent substrate.

6. (Previously Presented) The light emitting diode of claim 1, wherein a surface in one of the plurality of holes has a surface recombination velocity less than 10^5 cm/sec.

7. (Original) The light emitting diode of claim 1, wherein said first semiconductor layer, said active layer, and said second semiconductor layer comprise a group III element and a group V element.

8. (Original) The light emitting diode of claim 1, wherein said first semiconductor layer, said active layer, and said second semiconductor layer comprise GaN.

9. (Previously Presented) The light emitting diode of claim 1, wherein said periodically-arranged plurality of holes is periodic in at least one direction parallel to a plane of said second semiconductor layer.

10. (Previously Presented) The light emitting diode of claim 1, wherein said periodic arrangement comprises a planar lattice of holes.

11-12. (Canceled).

13. (Original) The light emitting diode of claim 10, wherein said planar lattice is a triangular lattice, square lattice, or a hexagonal lattice.

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14. (Original) The light emitting diode of claim 10, wherein

said planar lattice is a honeycomb lattice.

15. (Previously Presented) The light emitting diode of claim 14, wherein

said emitted light has an intensity and a polarization and the intensity of said emitted light is substantially independent of the polarization.

16. (Previously Presented) The light emitting diode of claim 1, wherein

said holes are filled with a dielectric.

17. (Original) The light emitting diode of claim 16, wherein

said dielectric is silicon oxide.

18. (Previously Presented) The light emitting diode of claim 1, wherein

the periodically-arranged plurality of holes form a photonic crystal having a photonic crystal band structure comprising one or more bands with edges; and

an energy of said emitted light lies close to an edge of a band of the photonic crystal band structure.

19. (Previously Presented) The light emitting diode of claim 18, wherein

the product of a rate of spontaneous emission of the light emitting diode and an efficiency of light extraction of the light emitting diode is greater at an energy close to said band edge than at a plurality of energies away from said band edge.

20. (Original) The light emitting diode of claim 16, wherein

the dielectric constants of said dielectric, said active layer and said second semiconductor layer assume values between about 1 and about 16; and

said holes occupy between about 10% and about 50% of the area of said second semiconductor layer.

21. (Previously Presented) The light emitting diode of claim 1, wherein

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an intensity of light emitted in a direction normal to a plane of said second semiconductor layer is greater than an intensity of light emitted in a direction different from the normal of the plane of said second semiconductor layer.

22. (Previously Presented) The light emitting diode of claim 1, wherein

said first semiconductor layer and said second semiconductor layer each comprise at least one layer of a III-nitride material;

said active layer comprises InGaN;

said first and second electrode layers comprise at least one of Ag, Al, and Au;

said periodically-arranged plurality of holes is a triangular lattice of holes, wherein

a diameter of said holes is between about 0.3a and about 0.72a, wherein

a is the period of the periodic arrangement;

a depth of said holes is between about 0.375a and about 2a; and

said first and second semiconductor layers together form an epi-layer, having a thickness between about 0.375a and about 2a.

23. (Previously Presented) The light emitting diode of claim 1, wherein

said first semiconductor layer and said second semiconductor layer each comprise at least one layer of a III-nitride material;

said active layer comprises InGaN;

said first and second electrode layers comprise at least one of Ag, Al, and Au;

said periodically-arranged plurality of holes is a triangular lattice of holes, wherein

a diameter of said holes is between about 0.3a and about 0.72a, wherein

a is the period of the periodic arrangement;

a depth of said holes is greater than about 2a; and

said first and second semiconductor layers together have a thickness greater than about 4a.

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24. (Previously Presented) The light emitting diode of claim 1, wherein said light emitting diode is disposed in a package, the package comprising:

a support frame;

a heat sink disposed within said support frame for extracting heat from said light emitting diode, wherein

said light emitting diode is disposed over said heat sink;

a plurality of leads, electrically coupled to said light emitting diode; and

a transparent housing overlying the light emitting diode.

25. (Currently Amended) A light emitting diode comprising:

a first semiconductor layer doped with a first dopant, coupled to a first electrode layer;

an active layer overlying said first semiconductor layer, capable of emitting light;

a second semiconductor layer doped with a second dopant overlying said active layer, said first and second dopants being of opposite type;

a second electrode layer on said second semiconductor layer; and

a periodically-arranged plurality of holes formed in the second semiconductor layer and extending towards the first semiconductor layer, wherein:

the ratio of the period of said periodic arrangement and the wavelength of said emitted light in air is greater than about 0.1 and less than about 5;

a depth of at least one of the plurality of holes is such that the thickness of said second semiconductor layer at a bottom of said at least one of the plurality of holes is less than about one wavelength of said emitted light in said second semiconductor layer;

a portion of the second electrode layer is disposed in a region of the second semiconductor layer in which a portion of the plurality of holes are formed;

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when forward biased, light is emitted from at least a portion of the active layer disposed beneath a portion of the second electrode; and

at least one of said first semiconductor layer, said active layer, and said second semiconductor layer comprises a group III element and nitrogen.

26. (Previously Presented) The light emitting diode of claim 25, wherein said group III element is Gallium.

27. (Previously Presented) The light emitting diode of claim 25, wherein

a surface in one of the plurality of holes has a surface recombination velocity less than 10^5 cm/sec.

28. (Original) The light emitting diode of claim 25, wherein

said first dopant is n-type and said second dopant is p-type.

29. (Previously Presented) The light emitting diode of claim 25 wherein said first semiconductor layer overlies said first electrode layer.

30. (Previously Presented) The light emitting diode of claim 25, wherein

said first electrode layer partially overlies said first semiconductor layer; and

said first semiconductor layer overlies a substrate with a reflective surface.

31. (Previously Presented) The light emitting diode of claim 25, wherein

said first electrode layer partially overlies said first semiconductor layer;

said second electrode layer is reflective; and

said first semiconductor layer overlies a transparent substrate.

32. (Previously Presented) The light emitting diode of claim 25, wherein

said periodically-arranged plurality of holes is periodic in at least one direction parallel to a plane of said second semiconductor layer.

33. (Previously Presented) The light emitting diode of claim 25, wherein

said periodic arrangement comprises a planar lattice of holes.

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34-35. (Canceled).

36. (Original) The light emitting diode of claim 33, wherein

said planar lattice is a triangular lattice, a square lattice, or a hexagonal lattice.

37. (Original) The light emitting diode of claim 33, wherein

said planar lattice is a honeycomb lattice.

38. (Previously Presented) The light emitting diode of claim 37, wherein

said emitted light has an intensity and a polarization and the intensity of said emitted light is independent of the polarization.

39. (Previously Presented) The light emitting diode of claim 25, wherein

said holes are filled with a dielectric.

40. (Original) The light emitting diode of claim 39, wherein

said dielectric is silicon oxide.

41. (Previously Presented) The light emitting diode of claim 25, wherein

the periodically-arranged plurality of holes form a photonic crystal having a photonic crystal band structure comprising one or more bands with edges; and

an energy of said emitted light lies close to an edge of a band of the photonic crystal band structure.

42. (Previously Presented) The light emitting diode of claim 41, wherein

the product of a rate of spontaneous emission of the light emitting diode and an efficiency of light extraction of the light emitting diode is greater at an energy close to said band edge than at a plurality of energies away from said band edge.

43. (Previously Presented) The light emitting diode of claim 39, wherein

dielectric constants of said dielectric, said first semiconductor layer, and said second semiconductor layer assume values between about 1 and about 16; and

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said holes occupy between about 10% and about 50% of the area of said second semiconductor layer.

44. (Previously Presented) The light emitting diode claim of 25, wherein

an intensity of light emitted in a direction normal to a plane of said second semiconductor layer is greater than an intensity of light emitted in a direction different from a normal of the plane of said second semiconductor layer.

45. (Previously Presented) The light emitting diode of claim 25, wherein

said first semiconductor layer and said second semiconductor layer each comprise at least one layer of a III-nitride material;

said active layer comprises InGaN;

said periodically-arranged plurality of holes is a triangular lattice of holes, wherein

a diameter of said holes is between about 0.3a and about 0.72a, wherein

a is the period of the periodically-arranged plurality of holes;

a depth of said holes is between about 0.375a and about 2a; and

said first and second semiconductor layers together form an epi-layer, having a thickness between about 0.375a and about 2a.

46. (Previously Presented) The light emitting diode of claim 25, wherein

said first semiconductor layer and said second semiconductor layer each comprise at least one layer of a III-nitride material;

said active layer comprises InGaN;

said periodically-arranged plurality of holes is a triangular lattice of holes, wherein

a diameter of said holes is between about 0.3a and about 0.72a, wherein

a is the period of the periodically-arranged plurality of holes;

a depth of said holes is greater than about 2a; and

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said first and second semiconductor layers together have a thickness greater than about 4a.

47-92. (Canceled).

93. (Previously Presented) The light emitting diode of claim 1, wherein at least one of the holes extends through the second semiconductor layer and into the active region.

94. (Previously Presented) The light emitting diode of claim 1, wherein at least one of the holes extends through the second semiconductor layer, through the active region, and into the first semiconductor layer.

95. (Previously Presented) The light emitting diode of claim 1, wherein the periodically arranged plurality of holes comprises parallel grooves.

96. (Previously Presented) The light emitting diode of claim 25, wherein at least one of the holes extends through the second semiconductor layer and into the active region.

97. (Previously Presented) The light emitting diode of claim 25, wherein at least one of the holes extends through the second semiconductor layer, through the active region, and into the first semiconductor layer.

98. (Previously Presented) The light emitting diode of claim 25, wherein the periodically arranged plurality of holes comprises parallel grooves.

99. (Previously Presented) The light emitting diode of claim 22, wherein a diameter of said holes is about 0.72a and said holes are filled with air.

100. (Previously Presented) The light emitting diode of claim 22, wherein said light, emitted by said active layer, has a frequency between about 0.66(c/a) and about 0.75(c/a), wherein c is the speed of light in air.

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101. (Previously Presented) The light emitting diode of claim 23, wherein said holes are filled with air.

102. (Previously Presented) The light emitting diode of claim 23, wherein said light, emitted by said active layer has a frequency in one of the ranges of about 0.2(c/a) to about 0.4(c/a) and about 0.5(c/a) to about 0.8(c/a), wherein c is the speed of light in air

103. (Previously Presented) The light emitting diode of claim 45, wherein a diameter of said holes is about 0.72a and said holes are filled with air.

104. (Previously Presented) The light emitting diode of claim 45, wherein said light, emitted by said active layer, has a frequency between about 0.66(c/a) and about 0.75(c/a), wherein c is the speed of light in air.

105. (Previously Presented) The light emitting diode of claim 46, wherein said holes are filled with air.

106. (Previously Presented) The light emitting diode of claim 46, wherein said light, emitted by said active layer has a frequency in one of the ranges of about 0.2(c/a) to about 0.4(c/a) and about 0.5(c/a) to about 0.8(c/a), wherein c is the speed of light in air.

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